STRATEGY RESEARCH PROJECT

MINE COUNTERMEASURES: A COMPARATIVE ANALYSIS OF US NAVY MINE COUNTERMEASURES 1999 VS 2020

BY

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USAWC CLASS OF 2000

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ABSTRACT

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The intent of this project is to complete a comparative analysis of current US Navy Mine Countermeasures capabilities versus projected capabilities in 2020. Following a historical background, this paper will review the current force structure, its capabilities and how this force operates. It will describe proposed changes to the force and alternative concepts of operation for the 2020 timeframe. Additionally, it will relate the impact of future mine countermeasures capabilities to the ability of naval forces to conduct operational maneuver from the sea and the impact to strategic sealift timelines.

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The author would like to specifically acknowledge the assistance of the Program Executive Office, Mine Warfare Airborne Mine Defense Program Office (PEO-210), United States Navy, for assistance in this endeavor. Current programming and project information has not only been of assistance in researching this paper, but will prove invaluable to the Navy as the organic mine countermeasures capabilities discussed herein are ultimately fielded. Their efforts will enable the United States Navy to keep its Mine Warfare capabilities on par with the rest of the fleet, helping the Navy to maintain its position as the premier Navy in the world.

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MINE COUNTERMEASURES CAPABILITIES FOR THE YEAR 2020

> A war in which enemies seldom meet and battle is rarely joined, but death and destruction always mark the field. Where the big ships fight their battles, and the little mine craft have already been to do their dull and dirty duty, in which there is no glory. Where the fighting fleets sail to victory, there are the seas of glory. But where the little ships go, there is the most dangerous sea. This is mine warfare.[1]
>
> — Arnold S. Lott
> LCDR, USN

The preeminent naval strategist, Alfred Thayer Mahan, based his greatest work on the premise that sea power was vital to national growth, prosperity, and security.[2] While there are many aspects of sea power, sea control is a cornerstone. In turn, mine warfare can play a key role in sea control. It is somewhat surprising then, that the United States Navy, unquestionably the greatest naval power in the world today, has paid such little homage to this aspect of naval warfare.

Some have argued that this is because mine warfare is seen as underhanded, not a gentlemanly way of conducting warfare.[3] Others point out the difficulty in assessing its effectiveness.[4] After all, if mines effectively close a harbor and no ships transit in or out, how does one measure the value of ships not sunk, personnel not transported or cargo not delivered? What if other ports or modes of transportation can make up the lion's share of the difference numerically, though maybe at a greater cost of time and/or money? The opinion of many inside of the mine warfare community might very well be that this branch of warfare is considered "second rate" because it is quiet, unglamorous and difficult to understand.

This paper will focus almost exclusively on the mine countermeasures portion of mine warfare, as opposed to mining or mine laying (which can be offensive or defensive in nature). Specifically, it will cover some highlights of the history of mine warfare in the United States Navy, review current mine countermeasures capabilities, including concept of operations and then, based on current programming efforts, compare current capabilities to expected capabilities in 2020. This comparison will be from a theater capability perspective, with generic time-phased force and deployment data (TPFDD) implications.

HISTORY

EARLY HISTORY

The history of mine warfare and the United States Armed forces dates back to 1777 and the American revolutionary War. In December of that year, George Washington authorized David Bushnell to proceed with a plan of floating explosive charges down the Delaware River towards British warships anchored at Philadelphia.[5]

These newly invented sea mines, termed "torpedoes" by their inventor, were simply watertight kegs, charged with gunpowder, actuated by a flintlock firing mechanism and suspended below the

surface of the water by a float.[6] For a variety of reasons, none of these devices ever contacted the hulls of the ships for which they were intended.

This initial mining operation proved to be the only use of this device during the Revolutionary War and an inauspicious start for the United States in mine warfare. The entire operation may even have gone unnoticed by the British, had it not been for the death of two boys, who found one of the kegs and detonated it in the process of trying to retrieve it.[7]

The first documented use of a mine countermeasure device occurred in 1862, during the American Civil War. Union naval forces constructed a raft with grappling hooks attached in order to "catch" the mooring lines of mines [torpedoes].[8] A similar "mine catcher" was rigged to the sloop Brooklyn, which preceded Admiral Farragut into Mobile Bay in 1864.[9] This foray into the area of mine countermeasures, although successful in terms of the capture of the forts protecting Mobile Bay and ultimately the city of Mobile in 1865, was not without the loss of the monitor Tecumseh.[10]

WORLD WAR I

For the remainder of the 19th century, the United States did very little in developing this emerging aspect of warfare and upon entering World War I in 1917, was in virtually the same position with respect to capabilities as at the end of the Civil War.[11] Nearly all mines used during the war were moored, contact mines (requiring a vessel to impact against them to actuate). Countermeasures, or minesweeping, were conducted by dragging a cable horizontally through the water, either behind two ships or paravaned behind one, creating a swept path.[12] The United States Navy became adept at these procedures, clearing up the North Sea Barrage following the war, and thus became proficient with respect to the state of the art technology, procedures and tactics of that era.

INTER-WAR PERIOD

Post-World War I, the United States prepared to continue development of mines, mine laying and mine sweeping technologies. A "Mine Building" was established at the Washington Navy Yard in 1919 to house physicists, engineers and draftsmen. This workshop was eventually incorporated within the Bureau of Ordnance, during its reorganization in 1929, and became part of the Naval Ordnance Laboratory.[13]

However, in spite of the appearance of dedication to mine warfare, progress and development projects was very slow and sporadic. Funding initially designated for mine work, was added to the general fund and was rapidly lost thereafter for its original appropriation.[14] Thus, by the time the inter-war period ended, "we can ...fairly say that in 1939 the United States was more or less where it had been twenty years before with respect to mine warfare."[15]

WORLD WAR II

While the United States entered World War II capable of sweeping World War I mines, mine technology had progressed significantly, with the Germans employing bottom, or ground, mines that utilized a magnetic sensor for actuation. Allied navies scrambled to find a countermeasure for this device. A magnetic sweep was developed, consisting of two electrodes towed behind a mine sweeping vessel, with a generator onboard which passed an electric current from one electrode to the other. This current produced a magnetic field behind the minesweeper that simulated the magnetic field of a ship passing over the mines.[16] As acoustic mines were developed, towed devices that produced noise, in the appropriate frequency ranges to simulate ships, followed rapidly. By the end of the war, reliable pressure sensors were developed for mine actuators. This enabled mines to require a combination of magnetic, acoustic and pressure signature of a vessel in order to satisfy the mine firing logic. Mine countermeasures were successfully developed which enabled satisfactory sweeping of magnetic and acoustic combinations, but to this day scientists have not been able to develop a pressure sweep. The only countermeasures for mines with a pressure sensors was to use a specially ballasted ship as a "guinea pig" sweep, or a ship self-defense tactic of transiting areas with pressure mines at speeds of 4 knots or less.[17]

KOREA

Following World War II, researchers judged that the ushering in of the atomic age and the associated requirement for extensive air defense would make laying offensive minefields nearly impossible and the use of defensive minefields obsolete. The days of mine warfare were, in effect, over.[18] This was the general mind set when the United States found its armed forces engaged in Korea.

Here World War I era mines, along with more modern weapons, delayed operations at Wonsan for weeks while too few minesweepers cleared minefields that had not been anticipated. "Admiral Jay said later that the main lesson of the Wonsan operation was that "no so-called subsidiary branch of the naval service, such as mine warfare, should ever be neglected or relegated to a minor role in the future.""[19]

The final result for the United States Navy was that mine countermeasures were specifically given a higher priority than mine development, but that is not to say that mine warfare was given adequate consideration in the overall picture of appropriations.

MODERN ERA

Through the 1950's and 60's, the Mine Defense Laboratory at Panama City, FL continued promising research in minesweeping, minehunting, mine classification and mine neutralization, including the development of helicopter mine countermeasures. These technological advancements were put into use during Operation End Sweep, following the war in Vietnam. However, these clearance operations were made easier by the fact that we were clearing our own minefields.

Helicopters were next used in the Suez Canal in 1974, for disposal of mines from the Arab-Israeli wars of 1963 and 1973. However, by the end of the 1970's the progress made in mine countermeasures

capabilities, starting in the 1950's, was deteriorating. The mine countermeasures forces consisted of 21 helicopters and 21 wooden hulled minesweepers (3 active; 18 reserve) built in the early 50's or before.[20] The only significant new addition to the force was minehunting sonar for use by the helicopters. This sonar saw its first operational use in the Red Sea and Gulf of Suez in 1984. This was to combat mine-laying operations, against commercial shipping, that were attributed to Libyan leader Muammar Qaddafi.[21]

United States mine countermeasures forces were next called upon in 1987, to clear mines in the Arabian Gulf. Operation Earnest Will was designed to safely escort US-flagged, Kuwaiti tankers in and out of the gulf, between their ports and the southern end of the Straight of Hormuz. The mine sweeping forces assigned consisted of eight aging helicopters and six minesweepers built in the 1950's.

The late 1980's finally yielded some new assets. The first of a new, leading technology minesweeper, the MCM-1 Avenger class, was commissioned. The aging, Vietnam War era helicopters were replaced by a newer, more powerful model as well. However, no new minesweeping or hunting systems were introduced with the new helicopter.

Of these new platforms, only the helicopters were available for deployment to the Arabian Gulf during Desert Shield and Desert Storm. Even with the new helicopters the United States Navy was once again unprepared for the threat it would have to face. Deficiencies in offensive and very shallow water mine countermeasures strategy and capabilities significantly impacted amphibious assault operations[22] and showed the vital importance of incorporating mine countermeasures within the deployed fleet.

The advances of the late 1980's were rapidly followed in the early 1990's by a coastal minehunter, the MHC-51 Osprey class. Finally, in the mid-1990's USS Inchon, a USS Tripoli class amphibious assault helicopter carrier, was converted to a mine countermeasures support ship (LPH-12 to MCS-12). Due to CNO guidance, research and development has recently turned its attention from the dedicated mine countermeasures platforms to organic capabilities. More will be discussed later on this concept.

Today, entering the 21st Century, our helicopters and minesweepers are nearing 15 years old. The newest ships, the coastal minehunters, are nearly 10 years old. The support ship for these platforms is a refitted 30-year-old helicopter carrier that was designed to get marines to Vietnam. The historical pattern is clear, a cycle which begins when mines affect the United States during crisis or conflict. Mine

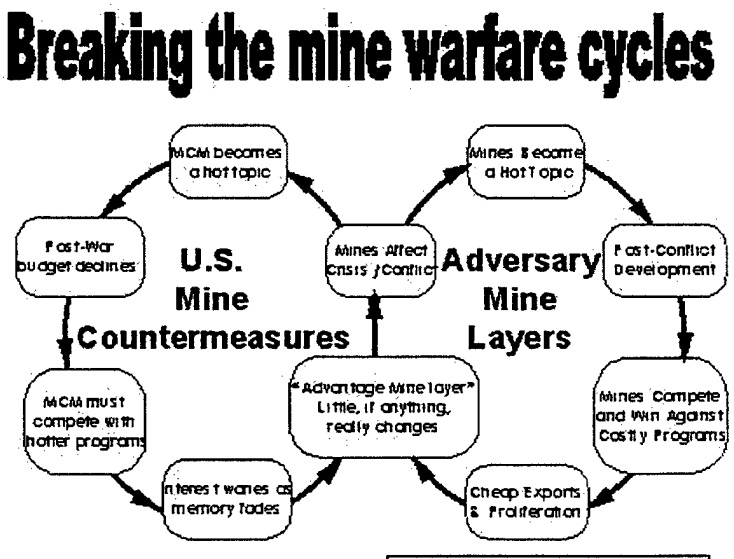


FIGURE 1 - MINE WARFARE CYCLES

countermeasures then comes into vogue, only to suffer during post-conflict budget declines. Competing with other warfare programs, mine countermeasures suffer as interest wanes and memory fades. Few changes occur, if any, and the advantage remains with the minelayer going into the next conflict or crisis. Our adversaries note this cycle as well and their corollary is see the success of mines during conflict, continue development of mine technology during peacetime and to capitalize on the high return for low investment associated with this weapon.[23] The United States Navy can ill afford to allow this cycle to continue.

CURRENT FORCE STRUCTURE & CAPABILITIES.

The United States Navy's dedicated mine countermeasures force is a triad of capabilities, consisting of aviation, surface and diving (EOD, marine mammals and Navy Special Warfare (NSW) forces) components. Each of these brings a unique capability to the mine clearance effort.

AVIATION

The aviation component consists of two airborne mine countermeasures squadrons (HM-14 and HM-15) which fly the MH-53E Sea Dragon helicopters and a reserve Helicopter Anti-Submarine Light Squadron (HSL-94). Each HM squadron contains ten aircraft and is designed to provide an eight aircraft detachment upon order. In 1999, HM-14 was directed to forward deploy a four aircraft detachment to Bahrain, maintaining a permanent presence in their primary area of responsibility. The MH-53E helicopters are capable of deploying via C-5 airlift or embarked on the USS Inchon, or other ships capable of supporting their flight operations and assigned to support them. A limited self-lift capability also exists using the aircraft's aerial refueling capability. These helicopters are capable of minehunting (detection of mine-like objects only), mechanical sweeping for moored mines, as well as influence sweeping for magnetic, acoustic or combination magnetic/acoustic mines.[24] Mine-like objects detected by a towed side-scan sonar, when minehunting, are typically passed off to EOD personnel, or surface minesweepers for further classification, exploitation and/or neutralization.

The HSL squadron is limited to deployment of a single contingency detachment. This detachment is only capable of conducting minehunting operations for moored mines. It utilizes the SH-2G Sea Sprite helicopter and the Magic Lantern Deployment Contingency (ML(DC)) System. The ML(DC) is a laser-based electro-optic system[25] which is serving as the prototype for future capabilities.

SURFACE

Surface assets consist of the MCM-1 Avenger class minesweeper, the smaller MHC-51 Osprey class coastal minehunter and the USS Inchon, the mine countermeasures support ship. The Avenger class ships are equipped to conduct minehunting and classification as well as mechanical and influence minesweeping. Additionally, they can destroy moored and bottom mines utilizing a remotely operated submersible vehicle (ROSV) designated the AN/SLQ-48.[26] Avenger class ships are also capable of providing limited support for EOD diver units.

The Osprey class minehunters are capable of minehunting, classification and neutralization of moored and bottom mines. They utilize a variable depth sonar and the same ROSV employed by the Avenger class minesweepers.[27] Osprey class ships can also provide limited support to EOD divers.

Both the Avenger and Osprey class vessels are capable of deploying overseas. However, due to their size, they are limited in endurance. A "mother" ship will accompany their transit, refueling them about every third day and provisioning food weekly. Osprey class ships have a maximum speed of ten knots, Avenger class fourteen, and both transit a approximately eight knots with a "mother" ship. They can also be loaded aboard specialized heavy-lift ships for transit into theater.[28]

The USS Inchon (MCS-12) is a converted Amphibious Assault Helicopter Carrier, the only ship in its class. As a mine countermeasures support ship, it serves as the launch, recovery and maintenance facilities for the mine countermeasures helicopters as well as the operating, logistics and maintenance platform for EOD assets. It also provides logistical support, including refueling, for Avenger and Osprey class vessels deployed as part of the Mine Countermeasures Squadron, Group or Task Force. Additionally, Inchon provides state-of-the-art C^4I systems, mission planning, execution and evaluation systems for the Mine Countermeasures Squadron, Group or Task Force Commander and his staff[29] and enables full integration with the Carrier Battle Group or Marine Amphibious Ready Group (ARG).

DIVERS

Explosive Ordnance Disposal and Naval Special Warfare detachments provide the third leg of the mine countermeasures triad. NSW detachments are extremely specialized in nature, conducting mine neutralization, exploitation and clearance operations in the very shallow water (i.e. 10-40') environment. These operations include the detection and destruction of mines and obstacles in order to clear lanes for amphibious assault operations.[30]

EOD detachments are comprised of divers or teams of divers and marine mammal systems. Divers conduct search operations and/or prosecute contacts obtained by airborne or surface platforms. Contacts positively identified as mines can be either neutralized or recovered for exploitation. Exploitation is invaluable for determining mine sensitivity and sensor operating characteristics for influence sweeping operations.

Marine mammal systems incorporate specially trained Atlantic and Pacific bottlenose dolphins and sea lions for mine detection and neutralization.[31] Specially designed tanks allow deployment of mammal systems to be accomplished via ships or strategic airlift. Transportation between coastal operating areas and airfields, when deployed by air, can be by truck or heavy lift helicopters.[32]

CURRENT CONCEPT OF OPERATIONS

There are a wide variety of scenarios in which mined ports or sea lines of communication would need to be cleared. Mine countermeasures should begin well prior to hostilities, with bottom-mapping, oceanographic and hydrographic surveys as well as surveillance and intelligence gathering operations; all

designed to provide a complete awareness of the battlespace and the threat. For ease of discussion, the concept of operations will be limited to the mine countermeasure activities of hunting sweeping and diving and the related command and control of the units conducting these operations. The scenario will consist of mine countermeasures operations conducted following the mining of a friendly or neutral port with an adjacent aerial port of debarkation. The enemy is not capable of projecting power into this area following the initial mining incident. Mine clearance operations are required to enable build up of friendly forces for follow-on operations. Current United States Navy capabilities would require dedicated mine countermeasures platforms to combat this mining scenario.

The dedicated mine countermeasures effort synergistically combines all three legs of the triad in integrated operations, optimizing the strengths of each individual component. Mine Countermeasures Group command and staff elements, aviation and EOD units are rapidly transportable via strategic airlift. A standard eight helicopter detachment can begin deployment within seventy-two hours of notification, moved to any theater within one week, and commence full operations between N+10 and N+15, depending on support facilities in theater. Command and staff and EOD units can be in theater and operating in even less time, as they do not have the same challenges of disassembly, reassembly and testing of the helicopters. EOD equipment does include a transportable decompression chamber to deal with diver casualties and the command and staff element can deploy a complete C^4I MILVAN complex, if they will be shore based.

If a particular theater has forward deployed surface minesweepers or hunters, mine countermeasures could commence on order. Integrated operations, involving all legs of the triad, could commence within seven to ten days after notification of units based in the continental United States (CONUS). Forward-deployed surface units are only currently available in the Arabian Gulf and Japan. While these locations support the most likely major theater war (MTW) scenarios, there are many additional areas where the threat of mining exists. Transit speed of a surface minesweeping group is approximately eight knots. Homeported in the Gulf of Mexico, this means nearly thirty days to cross the Atlantic Ocean, just to enter the Mediterranean and fifty days total to reach the Strait of Hormuz. Prior to the arrival of surface units, operations could begin with EOD and aviation units, but at a significantly slower clearance rate.

This scenario, the air deployment of command and staff element, aviation and EOD units, presents the most favorable timeline for United States forces. However, it requires a significant infrastructure to support units ashore. An alternative to keeping these units ashore would be to embark them on naval assets in theater, though this would typically mean taking a ship from the Amphibious Ready Group (ARG). This is often an unacceptable solution and is the specific reason for the conversion of the USS Inchon. Homeported in the Gulf of Mexico, USS Inchon could be in any theater within thirty days, provided it was not escorting surface mine countermeasures vessels. Escorting these vessels effectively doubles USS Inchon's transit time.

The Commander, US Pacific Fleet, simulated the deployment of an expeditionary Mine Countermeasures Group during Joint Fleet Exercise 98-1. This exercise included an eight aircraft helicopter detachment, four surface minesweepers, two EOD diver detachments and two EOD marine mammal detachments. Although this exercise simulated the clearance of an amphibious objective area (AOA), its results are transportable to clearance of an anchorage area, channel and harbor facility. Following arrival of all units, clearance of the AOA was successfully completed within nine days and fully met the commander's objectives for commencement of follow-on operations.[33]

Assuming force deployment follows a scenario similar to that discussed above, a single mined port could be opened up in theater within eighteen days (inclusive of transit time) of the deployment order. Operations requiring multiple ports would require deployment of more than one aircraft detachment and additional EOD detachments. It is not likely that two ports, separated by any significant distance, could be opened up in the same time frame, as there would not be sufficient surface assets to work both ports. (The only theater, in which multiple ports could possibly be opened, within a fourteen to eighteen day period, would be the Arabian Gulf. Here, no delays in the commencement of fully integrated mine countermeasures operations exist at all, as presently, EOD, aviation and surface assets are all forward deployed in theater.[34]) Again, tempo of operations could be accelerated by the presence of a mine countermeasures support platform, but there would usually be a delay getting it into theater.

Several other factors could significantly affect port clearance for delivery of follow-on forces. These include, but are not limited to, attrition of mine countermeasures forces, weather conditions (e.g. excessive sea states hampering surface and diver operations), sea bottom topography conditions which preclude minehunting (e.g. high density of bottom clutter generating too many mine-like contacts, or soft mud allowing mines to bury) and enemy reseeding of cleared areas.

In summary, there are many factors that affect the timeliness of mine clearance operations. Provided a developing crisis is correctly assessed, mine countermeasures units are deployed promptly, and airlift is available to move the forces, current mine countermeasures capabilities allow for sequential clearance of ports required for arrival of sealift elements. However, given the slow transit speed of surface minesweepers and the limited number of assets, any significant breakdown in threat assessment, delay in deployment orders, or shortfall of lift could easily lead to another "Wonsan Harbor" and delays of weeks to clear minefields that were not properly anticipated.[35]

FUTURE CAPABILITIES

My goal is to go organic.[36]

Admiral J.L. Johnson, USN
Chief of Naval Operations July 1997

With this statement, Admiral Johnson succinctly summarized the current mine countermeasures research and development focus, as well as providing insight into force structure for the first two decades

21st century. The intent is to shift emphasis away from the historical dedicated mine countermeasures platforms and find ways of integrating this capability within, organic to, the battle group. Numerous changes have been initiated, not only affecting structure, but by their very nature affecting the future concept of operations as well.

EOD

EOD force structure and capability is likely to be affected the least by the upcoming changes. Current EOD force structure supports many operations besides mine countermeasures and it is therefore unlikely that even drastic changes in the conduct of mine countermeasures will generate a significant change in these forces. Current force enhancements for EOD include better mobile support facilities that will provide field diver recompression treatment and improved maintenance for diving equipment. These will directly impact safety and sustainability. Additionally, improvements are expected for divers' equipment, hand-held sonar, underwater explosives and firing mechanisms as well as systems for recovering and exploiting mines.[37] However, while these will increase the effectiveness and efficiency of EOD operations, they will not yield any magnitude of reduction in the overall time required for the conduct of mine countermeasures operations.

SURFACE AND SUBMARINE

Many changes are underway for surface mine countermeasures capabilities, most related directly to the integration of organic capabilities. Foremost among changes for the surface community is the Remote Minehunting System (RMS). Fleet units have been operating and evaluating the prototype/contingency operating system since the mid-1990s. Ultimately this system will be deployed on all thirty-one Spruance class (DD-963) and fifty-seven Arleigh Burke class (DDG-51) destroyers, or approximately seventy-five percent of the fleet combatants.[38] The RMS will consist of a remotely operated platform that will tow a side-scan sonar or laser line-scan system.

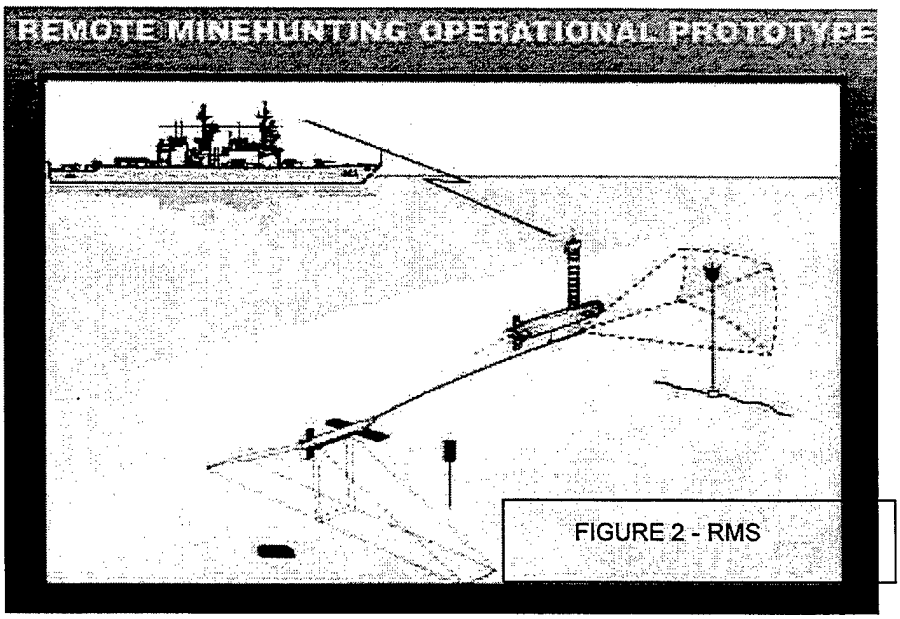


FIGURE 2 - RMS

Similar to RMS, a long-term mine reconnaissance system is planned for deployment aboard submarines. This is to be an unmanned, remotely operated system, allowing for clandestine reconnaissance of potential minefields in anticipated

operating areas.[39] In order to remain undetected, the submarine will operate this device through an umbilical chord. Additionally, improved sonar systems will give submarines a mine-like contact detection and avoidance capability.[40]

These changes should provide a great enhancement to the battle fleet, as well as to submarine forces operating independently or in support of Special Operations forces. The capability to detect mine-like contacts and identify a potential minefield without suffering the loss of a ship or personnel enhances force protection. These systems may also be used to assist in delineating the boundaries of minefields and circumnavigating them if possible, enhancing maneuverability. However, none of these surface or submarine systems provides for the neutralization of the mines located. This unanswered requirement is vital to the development of future concepts of operations.

Another significant impact to surface vessel capabilities will be the decommissioning of the USS Inchon. While there has been a great deal of discussion surrounding the replacement of this asset, a new mine countermeasures support ship is not currently programmed. The United States General Accounting Office reported its opposition to the Navy's expenditures for USS Inchon. The report stated, "These command, control and support activities can be provided from existing ships and on-shore locations."[41] In truth, there is not another ship available without taking an amphibious assault asset from the Marine Corps and it is not always feasible to use on-shore lodgements. Loss of this dedicated mine countermeasures support vessel will be detrimental to the sustainment of mine countermeasures operations and to the command and control of mine countermeasures platforms. This will be further discussed under future concepts of operations.

AVIATION

The greatest number and magnitude of changes is coming within the airborne mine countermeasures leg of the triad. Naval Aviation leadership has embraced the "Helicopter Master Plan" which calls for the reduction of seven current type/model/series of helicopters to two, prior to 2020.[42] This will also lead to a change in the structure of the United States Navy helicopter communities, although the extent of this has not yet been determined. As it specifically relates to mine countermeasures, the Helicopter Mine Countermeasures community (HM) will transition from the MH-53E to the CH-60S by approximately 2010. Additionally, the Helicopter Combat Support community (HC) will complete transition from the CH-46 to the CH-60S by approximately 2006 and there will likely be a merging of the HM and HC communities. (The HC community provides one and two aircraft detachments to fleet auxiliary ships, for vertical replenishment of deployed naval vessels, and large deck amphibious ships (LHD/LHA's), for search and rescue.) Lastly, the CH-60S will also be incorporated within the Helicopter Anti-submarine community (HS) and deploy with each aircraft carrier. (An HS squadron has ten aircraft and may deploy with as many as six CH-60S airframes for logistics; the other four will be the SH-60R to conduct anti-submarine, anti-surface and combat search and rescue missions.)

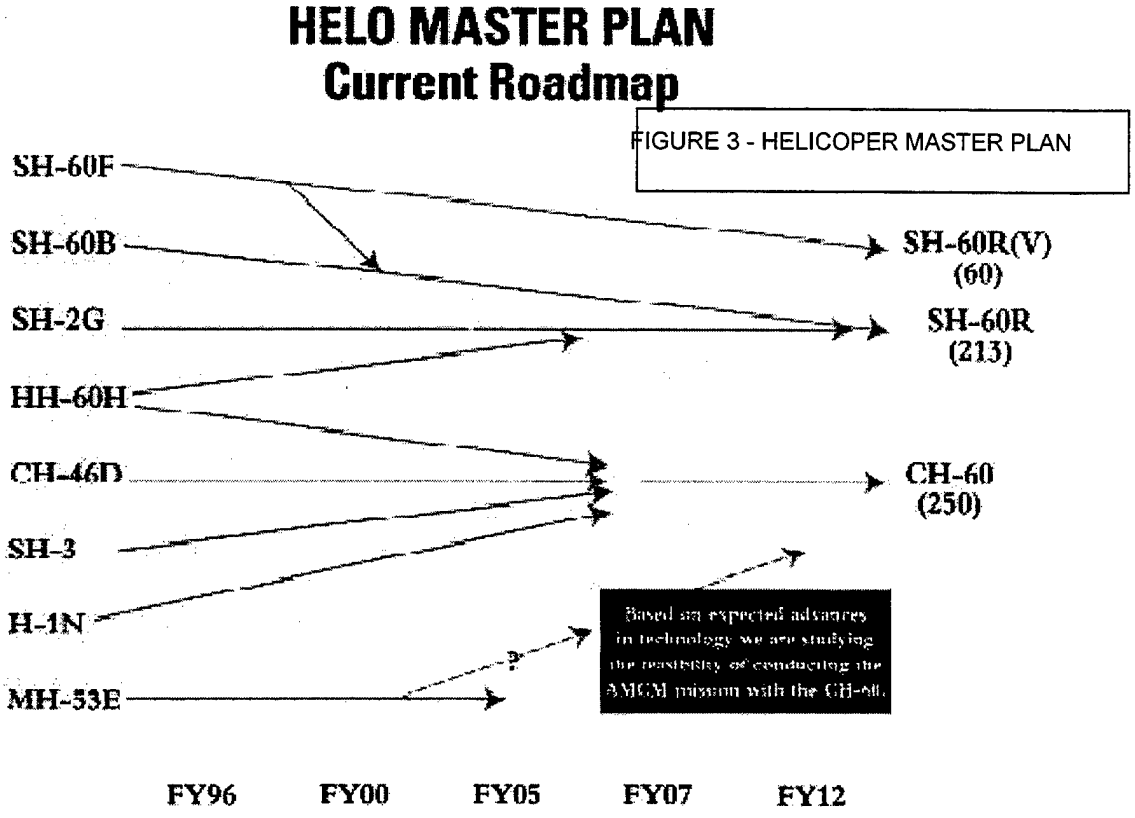
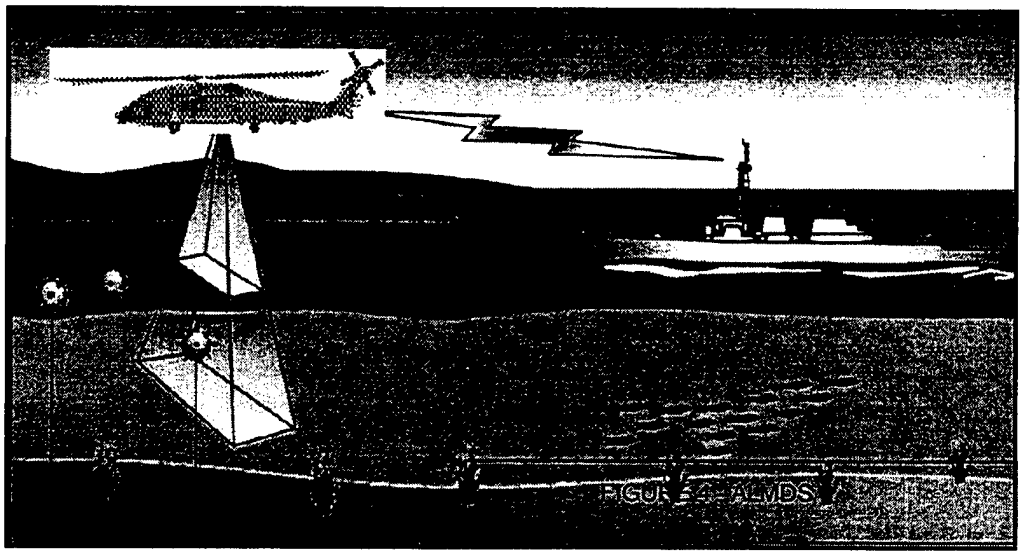


FIGURE 3 - HELICOPER MASTER PLAN

These changes have significant implications. The CH-60S will be the only helicopter capable of conducting mine countermeasures missions. There is no definite plan to maintain dedicated mine countermeasures detachments if/when the HM and HC communities merge. The HS community, although it will be equipped with the CH-60S, will find it difficult, if not impossible, to be trained in all warfare areas. The ML(DC) is the only existing airborne mine countermeasures system not used exclusively by the MH-53E. In other words, while the loss of the MH-53E has already been programmed, the systems required for the CH-60S to replace it are all in various stages of research and development. Furthermore, there has not been a single new system, for airborne mine countermeasures, deployed to the fleet in over 15 years. To field an entirely new suite of systems by 2006 seems overly ambitious. However, the systems currently under development for the CH-60S, do cover the entire spectrum of mine countermeasures requirements. The footprint associated with these proposed systems is also smaller than that of the MH-53E systems. They are smaller in size, lighter in weight and each can be carried internal to the CH-60S helicopter. (Currently, the MH-53E utilizes a large hydrofoil sled for magnetic influence sweeping which is streamed from a beach site or lowered into the water from a ship's crane.) These attributes are critical for fleet integration.

The first of these new systems is the Airborne Laser Mine Detection System (ALMDS), based on a laser radar, or LIDAR (Light Detection and ranging). While this technology has been used for a number

of years in other applications, it has only recently reached a stage of precision for detecting objects such as mines.[43] The ML(DC), currently operated by HSL-94 on its SH-2G's, is a LIDAR based system that has helped refine the technology for this application. The ALMDS for the CH-60S will be pod mounted, making it easier to install on any CH-60S helicopter.[44] Currently the ALMDS is expected to provide a minehunting capability for moored mines and shallow water (nominally defined as thirty to forty feet of water) bottom mines based on a combination of depth and clarity of the water column. This system will provide another minehunting capability, in addition to the surface and submarine capabilities, but still does not address the requirement for mine neutralization.



ALMDS	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
FY99 Funds Received		◆								
Draft Solicitation Issued		◆								
Issuance of Solicitation		◆								
(RFP)			◇							
ARB (TBD)			◇							
EDM Contract Award (TBD)										
Fabrication of Prototype					◇—◇					
Install and FQ&P					◇◇					
Instrumentation						◇				
Contractor Test						◇◇				
System Delivery						◇◇				
DT-IIA/DT-IIB (TECHEVAL)						◇◇				
Initial OP Look - DTA							◇◇			
OPEVAL							◇			
Milestone III							◇			
Production Contract Award										
Production Deliveries								◇◇	◇	

TABLE 1 - ALMDS PROGRAM SCHEDULE

In order to compliment the ALMDS, the Rapid Airborne Mine Clearance System (RAMICS) is under development, which will provide a mine neutralization capability for detected moored and shallow water bottom mines. This system centers around a special "supercavitating" thirty-millimeter projectile, capable

of travelling "tactical distances" in water and driving a chemical initiator through a casing into the mine explosive.[45] "Tactical distances" are currently only nominally defined, but are based on the combination of ranges to sight the target and successfully deliver the projectile, while maintaining sufficient stand-off distance to limit the risk to the helicopter and crew. LIDAR will be used for mine acquisition/reacquisition and provide aiming coordinates to the gun's fire control system. "A burst of approximately twenty-five rounds is fired at the mine with a high probability of one or more penetrating the warhead, causing positive destruction of the mine."[46]

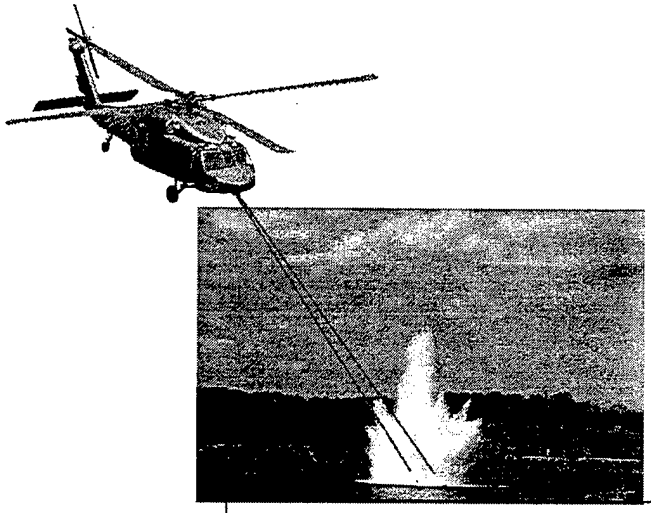


FIGURE 5 - RAMICS

	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06
ATD Complete								
Weapon Select								
Projectile Dev								
Milestone II								
EMD KAWD								
Targtg/Munit Dev								
Contractor Tests								
Govt T&E								
Production Kawd								

TABLE 2 - RAMICS PROGRAM SCHEDULE

An improved minehunting sonar is also being developed for the organic airborne mine countermeasures force. Airborne forces have used the current AN/AQS-14 towed side-scan sonar since the early 1980s. A follow-on version, the AN/AQS-20, has been in development since the mid-1980s.

The prototype is currently under test and evaluation. Production of this new sonar will not occur for the MH-53E, but rather it will serve as the basis for design, development and integration of the AN/AQS-20X for the CH-60S.[47] The AN/AQS-20X will likely be a laser based identification sensor, with the current sonar arrays replaced by laser arrays. This is a significant technological leap forward and will provide a great tactical advantage. The current sonar can locate mine-like contacts, but cannot classify with respect to "mine" or "non-mine" as will the new sensor. The AN/AQS-20X will provide a deeper water minehunting capability than the ALMDS and likewise will require a deeper neutralization capability than the RAMICS.

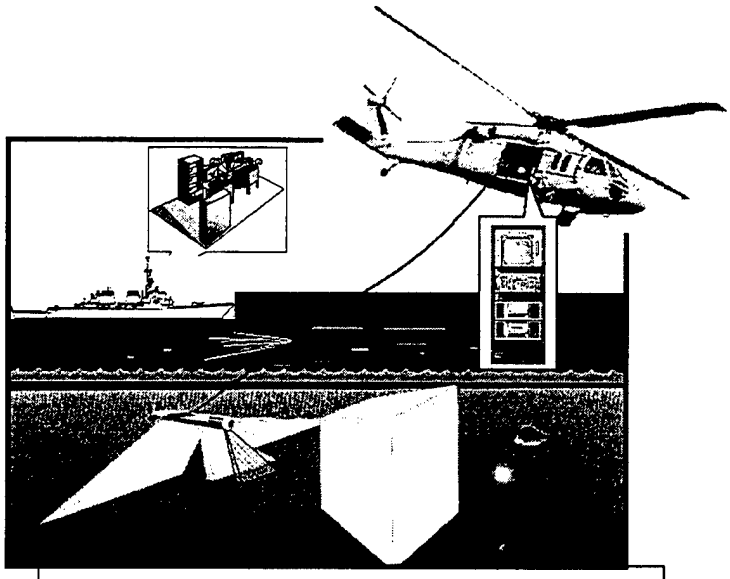


FIGURE 6 - AQS-20X

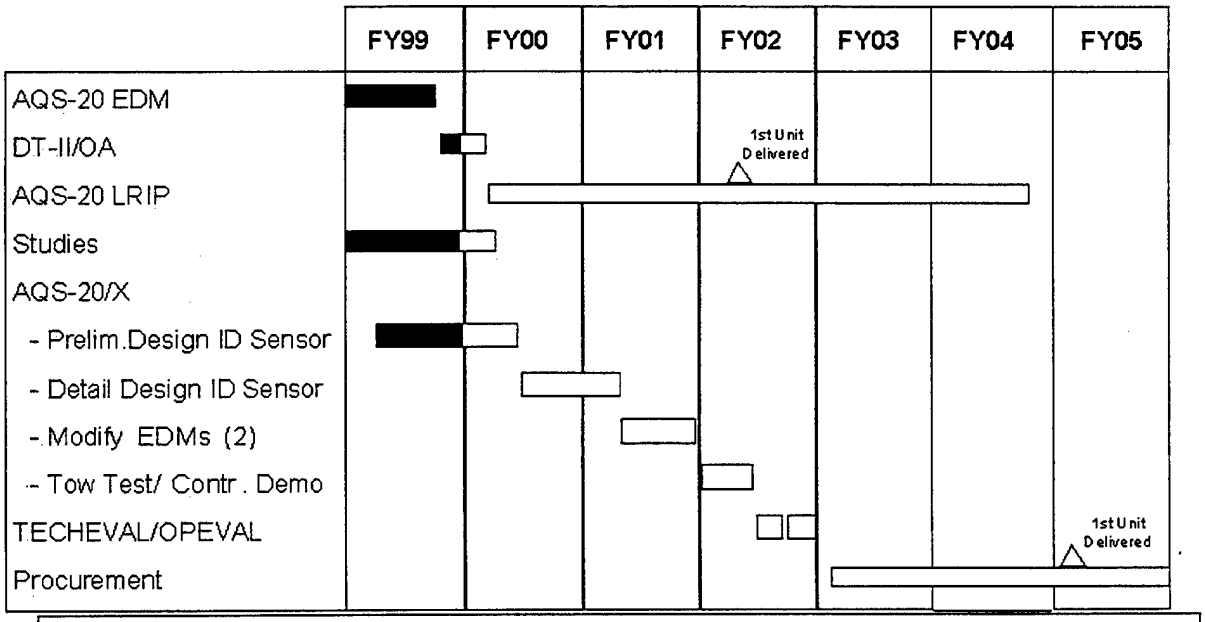
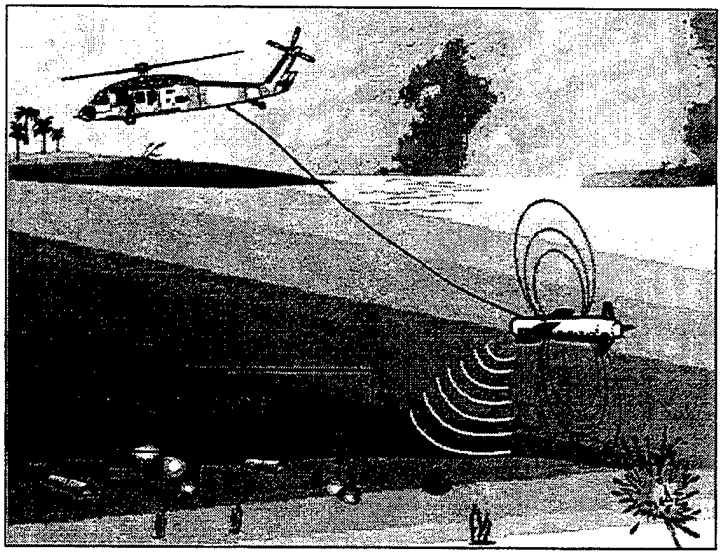


TABLE 3 - AQS-20X PROGRAM SCHEDULE

The Organic Airborne and Surface Influence Sweep (OASIS) is another towed system, under development to compliment the AN/AQS-20X and also provide a "sweeping" alternative to the neutralization capability of the RAMICS. This influence sweep is designed for operation against shallow water magnetic or magnetic/acoustic mines. It will be capable of operating at speeds of up to 40 knots

and be transportable within the CH-60S. Magnetic waveforms will be programmable, significantly enhancing the target threats against which it will be effective.[48] As its name implies, this system is envisioned for airborne and surface applications. Surface vessels will employ it in conjunction with a remotely operated vehicle, providing a compliment to the RMS. OASIS is expected to be effective against some targets too deep for RAMICS and will also be able to sweep in conditions where the water properties are not conducive to LIDAR targeting of mines. Its speed is significantly greater than current airborne and surface influence sweeps and will yield correspondingly greater coverage rates depending on its effective sweep width.



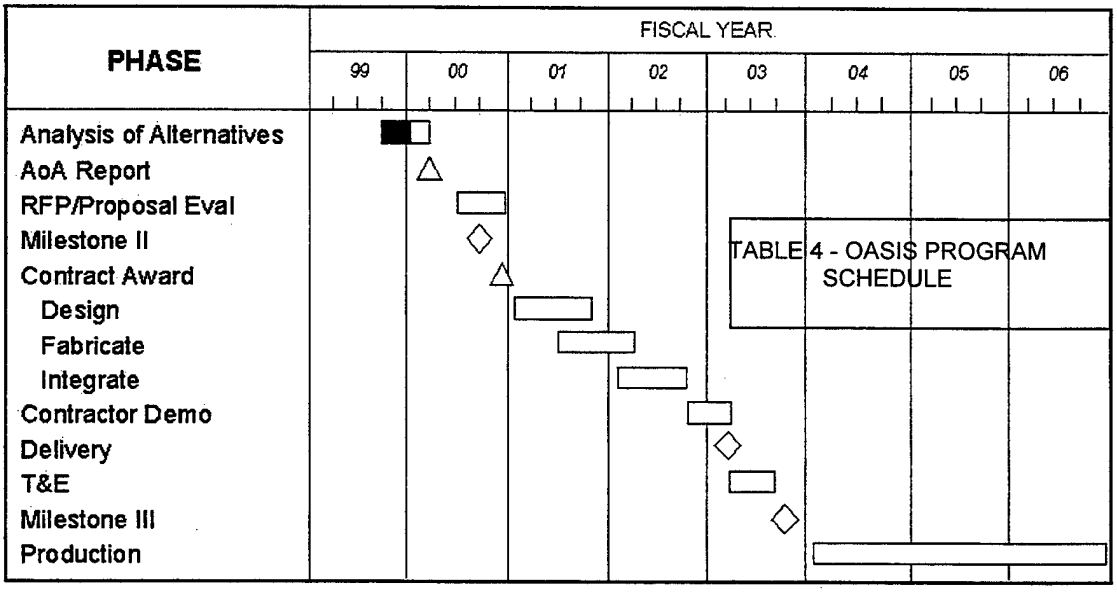
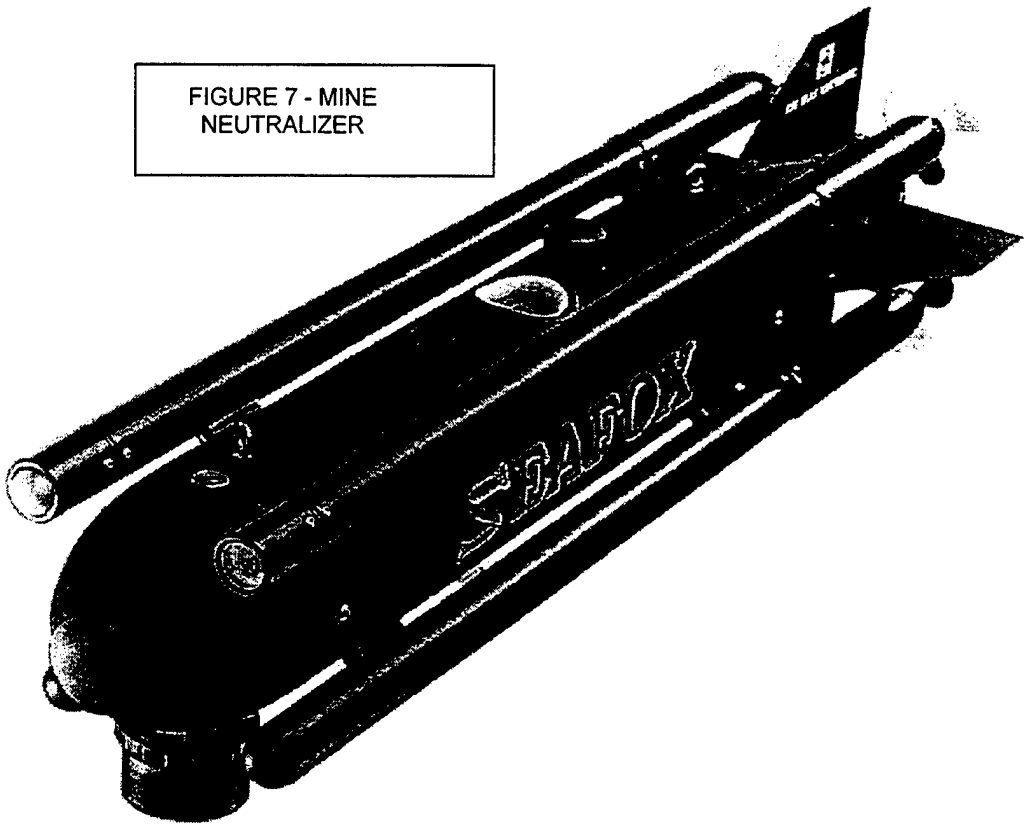


TABLE 4 - OASIS PROGRAM SCHEDULE

The Airborne Mine Neutralization System (AMNS) is the last of the new systems under development. This remotely operated system will be able to explosively neutralize unburied bottom and moored mines in deep or shallow water. The AMNS components will include an operator's console within the helicopter and maneuverable expendable mine neutralizers. The operator will be able to guide the neutralizer to a previously detected and classified target and, upon command, detonate its charge from an optimal position to neutralize the mine.[49] Fly-by-wire as well as radio control of the mine neutralizer are under evaluation. The day/night capability of this system will be another significant enhancement to current capabilities. The deep-water capabilities of the AMNS will bridge the gap between the deep minehunting capability of the AN/AQS-20X and the shallower capabilities of the RAMICS and OASIS.

The explosive neutralization capability also provides a countermeasure to pressure mines not currently available aside from EOD.

FIGURE 7 - MINE NEUTRALIZER



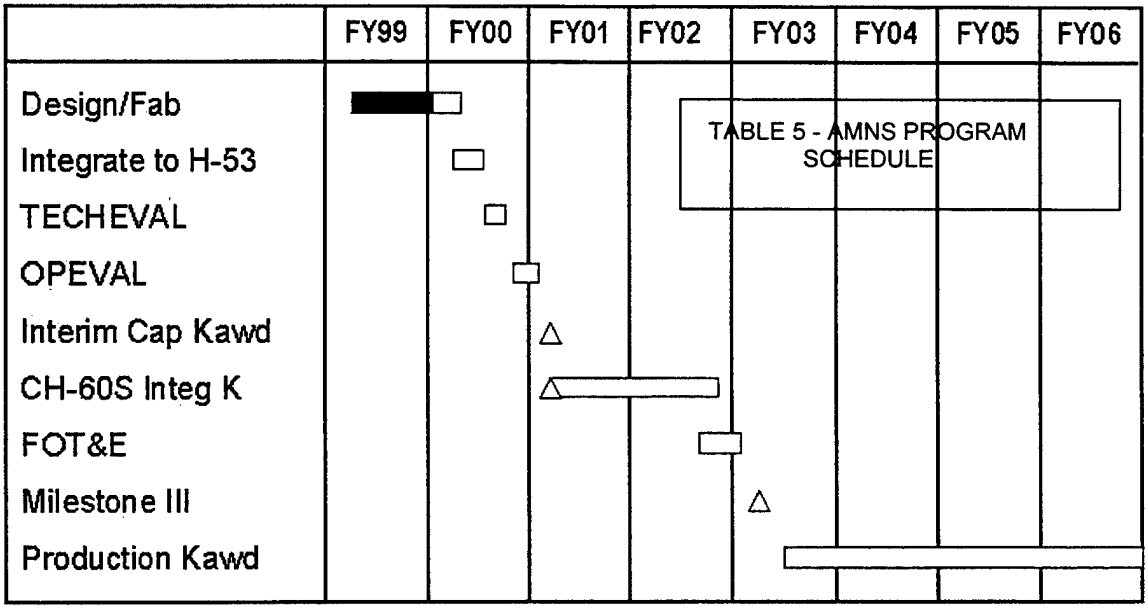


TABLE 5 - AMNS PROGRAM SCHEDULE

In summary, all systems currently under development are compatible with the CNO's desire to "go organic." Systems are in development to cover all aspects of mine countermeasures; minehunting, minesweeping and neutralization, against both moored and bottom mines, in shallow as well as deep

water. The timeline for fielding these systems are all based on production to begin between 2003 and 2005 with an Initial Operating Capability (IOC) for organic airborne mine countermeasures targeted for 2006.[50] This increase in capabilities and level of research and development is unprecedented for mine countermeasures during peacetime. The driving motivation is apparently equally split between the need to develop organic capabilities and the desire to eliminate the expense associated with the MH-53E. Future capabilities will exceed current capabilities only to the extent that development achieves currently anticipated parameters.

With the advent of these new, improved systems, it would appear that the United States Navy is on the verge of entering a grand new era of mine countermeasures. The resolve to complete the programs that have been undertaken is paramount. Robust, state-of-the-art systems will be employed from new platforms and be immediately available to the Battle group Commander. The last link to success will be in the execution. A review of possible concepts of operations for these new forces will show that there are still a number of issues that may be problematic.

CHALLENGES & FUTURE CONCEPT OF OPERATIONS

CHALLENGES

The enhanced capabilities, brought to the fleet by these new systems, bring with them new challenges for the Navy of 2020. First and foremost, organic mine countermeasures will present the Battle Fleet Commander new Command and Control (C2) issues. Mine countermeasures units currently operate under the tactical control of the commander of a Mine Countermeasures Squadron or Group. Future forces, organic to the battle group, will be under the Composite Warfare Commander, who will likely designate a Mine Warfare Commander from within the Battle Group. This commander will require use of helicopter and surface assets to conduct mine countermeasures operations. Helicopter assets are also likely to be required for their Air Warfare, Surface Warfare, Undersea Warfare, Search and Rescue and logistic capabilities. The destroyers are likely to be required for their strike, gunfire, Theater Ballistic Missile Defense, Air Warfare and Space and Electronic Warfare capabilities. While juggling allocation of assets to different warfare commanders is not new, Mine Warfare has not previously been at issue. It is also a very labor and time intensive warfare area and poorly understood by the rest of the Navy.

There will also be C2 challenges specific to the Mine Warfare Commander. The capability to conduct a mine countermeasure operation has never been requisite knowledge for fleet commanders. The suite of C4I systems currently used by the Mine Countermeasures Group Commander is not installed on any ship besides the USS Inchon and would be difficult to deploy aboard a ship that was already out to sea. While the elements may be present to conduct the operations themselves, organic C2 of those elements has not been programmed to date.

The organic mine countermeasures forces of 2020 may also be challenged by the lack of EOD personnel. Much like organic C2 capabilities, there is no program addressing the issue of how to provide the EOD capability as an inherent part of the Battle group. Should the need arise to conduct influence

sweeping operations, exploitation of the mine threat is the only means to obtain invaluable information. NSW detachments, currently deployed aboard aircraft carriers, may be able to bridge this gap. However, these forces are, by nature, high-demand/low-density units and will be assigned more critical roles in nearly all cases.

The next greatest challenge to the Navy in implementing organic mine countermeasures will be its effect on the composition of the dedicated mine countermeasures forces. As previously stated, the HM and HC communities will likely merge. This will generate an organic capability to a battle group consisting of two destroyers equipped with the RMS, divers from the NSW detachment aboard the aircraft carrier, and possibly as many as eleven CH-60S helicopters, if the carrier battle group is accompanied by an ARG. The helicopters would be available from the HS squadron on the carrier (six), fleet oiler (two), another auxiliary ship (one) and the ARG's LHA or LHD (two). However, as discussed next under "Future Concepts of Operations," extended dedication of these assets to mine countermeasures may not be feasible and a detachment of dedicated mine countermeasures helicopters could be required. There is no definitive plan that such a detachment will be available. Similarly, with all mine countermeasures programming directed towards development of organic capabilities, there is no plan for replacement of current surface mine sweepers and hunters.

Lastly, the Navy of the future is going to be challenged by the lack of full integration of the new organic capabilities. As previously mentioned, seventy-five percent of the Navy's combatant ships will be equipped with the new Remote Minehunting System. Conversely, a full quarter of the combatants will not have any inherent capability. The Surface Action Groups (SAG's) will deploy with a minehunting capability only, as the embarked SH-60R's will not be equipped, nor trained, to conduct organic mine countermeasures. Cruisers, often the main unit in a SAG, will possess no organic capability at all. Accompanying destroyers may have the RMS, but will not be equipped to neutralize any mines found with their minehunting system. Ships conducting independent steaming operations will face the same conditions, destroyers will be capable of minehunting only and cruisers will have no additional capability. Dedicated mine countermeasures ships may be capable of hunting their way through a minefield, but for a destroyer, this becomes a deadly game of "blind man's bluff."

FUTURE CONCEPTS OF OPERATIONS

The Navy and Marine Corps concepts for the future are expressed in "Forward...From the Sea" (FFTS) and "Operational Maneuver from the sea" (OMFTS). Clearly, naval forces will be required to operate in the littoral regions of the world, where the mine threat is greatest.[51] While using the sea as maneuver space and projecting power ashore from the littorals require an organic capability to combat mines, the concepts of increased stand-off range, Ship to Objective Maneuver (STOM) and reduced footprints ashore, lend themselves to delineating minefields, avoiding them or breaching them, vice clearing them.

The latest concept paper, for mine countermeasures and its role in littoral power projection, specifically mentions the limitations of the current U.S. capability "to conduct truly rapid breaching"[52] of minefields. It also bemoans the "operational pauses created by the slow, deliberate nature of MCM [mine countermeasures] operations."[53] These limitations apply specifically to mine countermeasures with respect to the maneuver and surprise required for amphibious assault operations. Organic capabilities will enhance maneuver and may assist in obtaining a rapid breaching capability. However, they are not optimal for extensive clearance operations associated with opening a port, or providing safe transit and anchorage areas for large port operations. These operations are slow and deliberate by nature. They are also critical to ensuring safe passage and protection of maritime pre-positioned stocks and supporting the strategic sealift required for the build up and sustainment of a substantial joint force.

The Navy may choose any of a number of mine countermeasures force structure options for the future. However, there are two clear paths from which to choose. The difference between the two lies in the incorporation of organic mine countermeasures capabilities as an adjunct to current dedicated capabilities, as opposed to organic at the expense of dedicated capabilities. The outcomes of these two options are at opposite ends of the spectrum. Force structures between these two extremes would likewise yield outcomes between the two scenarios depicted below.

Scenario #1: Organic Mine Countermeasures as a Force Multiplier

A 2020 scenario combining organic mine countermeasures forces with the expeditionary deployment of dedicated mine countermeasures forces would be a resounding success. As a crisis arose in any theater, the National Command Authorities would ask the often-postulated question, "Where is the closest aircraft carrier?" The Battle Group would arrive on scene, an aircraft carrier, cruiser, two destroyers and an oiler. The deployed ARG would arrive shortly thereafter, one LHA or LHD, one LPD, one LSD and a destroyer. Precursor minehunting operations would commence with the destroyers and CH-60S helicopters to validate the presence or absence of a mine threat. These organic forces could begin to counter any mines found, or could simply delineate the boundaries of the minefields and remain clear. Assuming that the threat warranted, notification of dedicated mine countermeasures forces would occur and their deployment could commence. Once on scene, dedicated forces would assume responsibility for the mine countermeasures operations and organic forces could continue with routine Battle Group and/or amphibious operations. In this scenario, based on the expected capabilities of the new systems[54] and because organic assets could begin attacking the problem immediately, the fourteen to eighteen days required for current day forces to open a single port could easily be surpassed.

Current Battle Group forces might only become aware of a mined port by losing a ship. Or, if it was feared that mining had occurred, forces might be inordinately delayed just trying to confirm whether or not mines had been laid. Currently programmed organic capabilities significantly reduce these hazards.

Scenario #2: Organic Mine Countermeasures as a Force Substitute

While there is no official discussion of doing away with dedicated forces at this time, its discussion is almost unavoidable. If the historic "Mine Warfare Cycles" (Figure 1) continue, the future capabilities may be organic only. This will lead to a different scenario. As budget constraints continue, and the "peace dividend" fails to materialize, the Navy could be forced to find further efficiencies. It is expected that fleet assets should be able to perform every type of operation that dedicated mine countermeasures forces can. Not being able to justify this "redundancy," the Navy might select to decommission all dedicated mine countermeasures units. The following scenario might develop:

As a crisis "heats up," a Battle Group arrives on scene. Hostilities increase and the nation we are supporting finds its ports blocked by an enemy mining campaign. United States assistance is requested. With no dedicated assets to deploy, a decision has to be made to either deny assistance to a friendly nation or obligate a Battle Group to extensive, time consuming, mine clearance operations, risking valuable assets.

The speed of any clearance operation is directly related to the number of assets dedicated to the mission. Even with full-time dedication of all organic capabilities, it is unlikely that a Battle Group would have sufficient organic mine countermeasures capability to open a port in less than three weeks. (With multiple ports mined, operations could easily continue for months.) As previously delineated, the Battle Group might be able to employ up to eleven CH-60S helicopters for mine countermeasures operations. However, no Battle Group Commander could fathom losing his logistic helicopter support for three weeks. Reducing the number of helicopters designated for mine countermeasures would further delay the operations. Furthermore, if the hostile nation had a diesel submarine threat, the mine countermeasures assets required to remain close to shore could not remain in such a vulnerable position. Due to this submarine threat, the Mine Warfare Commander might be directed to continue operations with only helicopters. Even without a submarine threat, there is always a risk, even to minesweepers designed for the task, that a destroyer could actuate a mine while minehunting and sink. The organic forces at this point would be overwhelmed. The end result would be considerable delays to the time-phased delivery of forces. If it is true that "the one, who gets there first, with the most, wins," in this scenario, it might not be us.

CONCLUSION

The United States finds itself in a world where it has no peer competitor. The fact that each of its branches of the armed forces has no equal makes it all the more likely that it will face asymmetrical threats. Mines present just such a threat. There are more than forty-eight navies with mine laying capabilities and at least thirty countries actively engaged in developing and manufacturing mines. Two thirds of these are exporting mines.[55] It is unreasonable to expect that the mine warfare cycles previously discussed will be broken, unless it is done by the United States Navy committing itself to developing and maintaining mine countermeasures capabilities at a rate matching those of the rest of the Naval Warfare areas.

In the opinion of the author, either of the two scenarios presented for 2020 is equally feasible. While having organic assets is certainly a great advantage, not maintaining a robust dedicated capability can be catastrophic. "History indicates that a significantly greater commitment is needed to institutionalize mine countermeasures to the status of a warfare mission area."[56] The future concepts for naval operations laid out in FFTS and OMFTS do not specifically chart the course for mine countermeasures. Future documents need to address the envisioned concept of operations and specify the required mix of organic and dedicated mine countermeasures capabilities.

Actual mine countermeasures operations are rarely required. Unfortunately, this may add another challenge to the planned organic force structure. Platforms with many mission essential tasks will tend to emphasize training and readiness in those missions with a higher visibility. History has proven that mine countermeasures systems, and hence capabilities, will probably not remain adequately tested and maintained. Similarly, personnel will not maintain a sufficient level of training in equipment operation nor tactical proficiency. In short, a great capability may exist in theory, but readiness will suffer in materiel and personnel.

Hopefully the Navy will learn the right lessons from the past. Organic mine countermeasures need to be viewed as a force multiplier, not a substitute for dedicated assets. Given current fiscal constraints, funding of programs should be primarily oriented towards developing and fielding organic capabilities that the fleet lacks or that will enhance the Navy's ability to perform its joint war fighting requirements. However, these developments should not be at the expense of maintaining current dedicated capabilities.

In many ways, the maintenance of a dedicated mine countermeasures force is similar to the strategic sea lift capability. It does not enhance the Navy's ability to maneuver. It does not project power ashore. Many years can go by before it is required. However, it does directly impact the ability to conduct joint operations. It directly affects the ability to get U.S. forces into theater, protecting what many see as a potential strategic center of gravity – Strategic Mobility. It took dramatic shortfalls, exhibited during the build up of forces for Operation Desert Storm, followed by direct intervention from the joint arena, for the Navy to appropriate the proper funding to strategic sea lift. Hopefully, the same will not be required to ensure a complete mine countermeasures capability is maintained.

The Navy needs to stay the course in aggressively pursuing organic mine countermeasures. These should be fully fielded by 2010. Then, the Navy should once again be looking to refurbish its dedicated mine countermeasures community in order to retain its position as the preeminent naval power in the world. The cost to recapitalize the dedicated forces, to include the full mine countermeasures triad, needs to be measured, not against historical mine countermeasures expenditures, but against the risk presented to strategic mobility by not refurbishing the force.

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ENDNOTES

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[23] Ibid., 19.

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[30] Ibid., 42-44, 50-52.

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[32] V.W. Jimenez, , P-JTFEX 98-1 End of Exercise Report (Corpus Christi, TX: Helicopter Mine Countermeasures Squadron 15, 1998), Enclosure 5, 2.

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